Space Weather Technical Forecast

Issued on Tuesday 15 October 2024 at 01:15 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance G1 Minor Storm day 1 (15 Oct). Chance of isolated M-flares persists.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate activity with a peak flare of M3.4 at 14/0017 UTC from AR3848 approaching the northwest limb. There are eight sunspot regions on the Earth facing disc, with AR3857 and AR3858 in the far southeast recently numbered. AR3848 remains of interest, as a large spot which had been largely inactive aside from the X1.8 on 09 Oct, until a recent M3.4 flare. This is now hard to observe, and will shortly be leaving the viable disk. AR3852 and AR3854 in the south-centre form a coupled pair of sunspots. While relatively inactive and also simplifying in visible appearance with the loss of intermediate spots, the regions continue to show some modest magnetic loop structure in e.g. SDO aia-211. AR3850 and AR3849 in the southwest also form a closely connected pair of spots, but are now largely consisting of a cluster of negative polarity spots with few very small positive polarity spots identifiable. The two new region on the east limb appear simple, but remain too close to the limb for an accurate analysis.

A number of CMEs have been observed in imagery, however these are all off the Earth-Sun line, and not thought Earth-directed.

Solar Wind / Geomagnetic Activity: Solar winds were initially slightly elevated around 420km/s but fell to background levels around 380km/s through the first half of the period despite a weak transitory feature. An increase in speeds back towards 400-420km/s was recorded following a CME arrival at approximately 14/1717 UTC. Density initially below average, rose to nearer average levels following the CME arrival. The Interplanetary magnetic field, Bt, was weak below 6nT to start, with a weak transitory feature visible through the UTC morning. Bt increased following CME arrival to become moderate, peaking at 10nT. The north-south component, Bz, varied weakly initially, becoming generally weakly negative following CME arrival, with a low of -7nT. Phi angle was largely positive (Away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp0-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at background. High energy electron flux (greater than 2MeV) observed by GOES16 was persistently Moderate with peak 638 pfu at 14/1845 UTC. The associated 24-hour fluence was below the Active threshold with a rising trend. The 15/0000UTC observed was 2.34e7 total pfu.

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Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: Ongoing slightly elevated solar winds and weak CME influence are expected to gradually ease through day 1 (15 Oct). However, there is a potential for elevated winds to return for a time on days 1-2 (15-16 Oct) due to any further transitory CME influence or a possible connection to coronal hole fast winds. A more notable coronal hole enhancement possible into day 4 (19 Oct) in association with the large CH80/+, currently near center disk.

Overall geomagnetic activity is expected to be mainly Quiet to Unsettled. There is a likelihood of Active intervals both to start and end the forecast associated with CME arrival or coronal hole influence, and there is a chance of isolated G1 Minor Storm intervals day 1 (15 Oct) given uncertainty with potential CME arrival.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES-18 is now largely at background, but there remains a slight chance of further enhancements given any significant flares. High energy electron flux is expected to continue rising as solar winds ease and the Van Allen belts expand outward again. This brings a chance of High flux, although tempered by any possible CME arrival or fast wind onset. The associated 24 hour fluence is expected to rise, but thought likely to remain generally below Active (1e8 total pfu).

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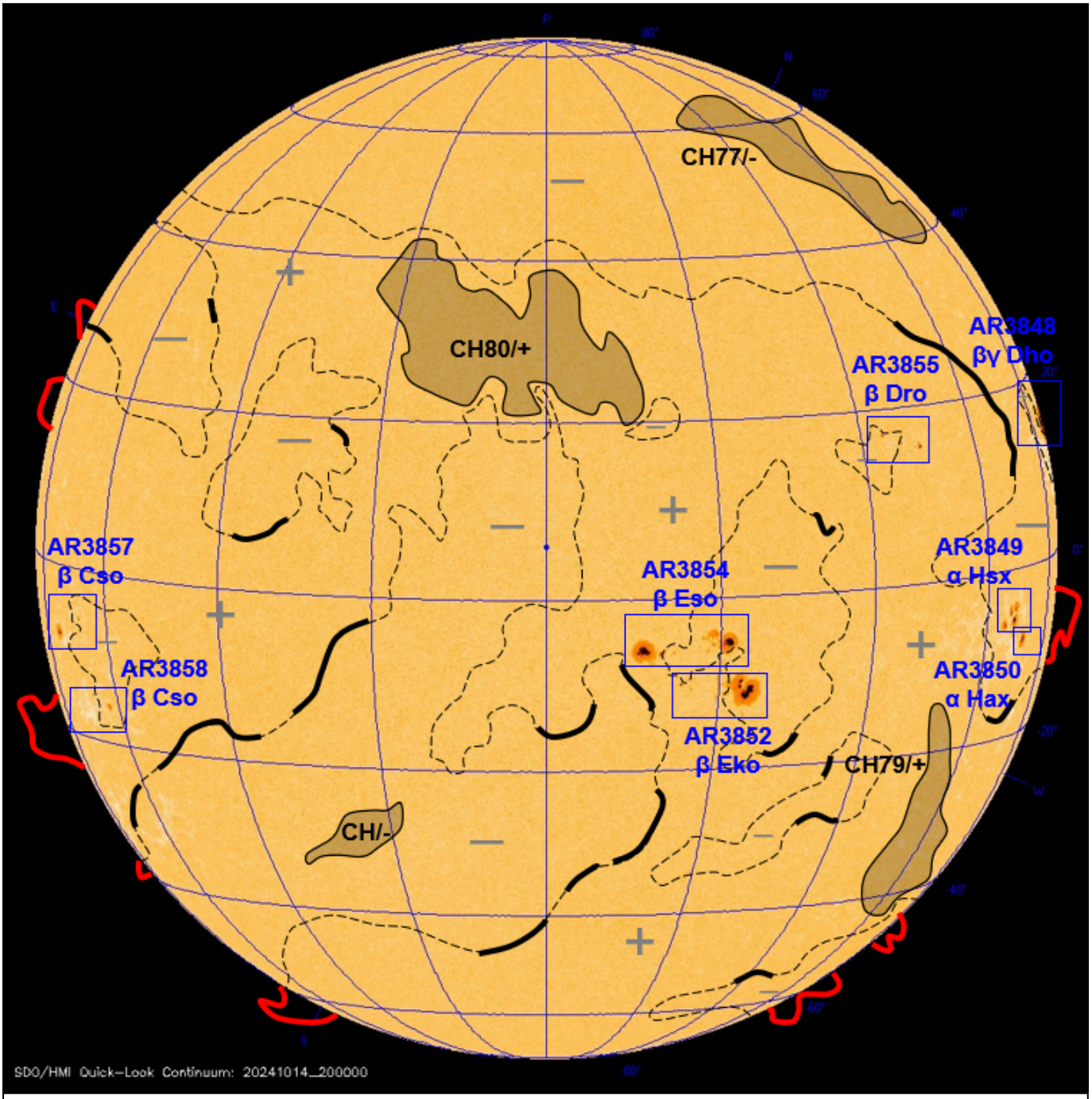
Figure 1: Solar Synoptic Map 14/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There is one potential Earth glancing CME in the forecast. This originated from an M2.1 flare from AR3854 in the east disc, with a glancing impact most likely on day 1 (15 Oct). The arrival time of this feature is low confidence, due to limited imagery for analysis, and may already be influencing the near Earth environment.

Ongoing slightly elevated solar winds and weak CME influence are expected to gradually ease through day 1 (15 Oct). However, there is a potential for elevated winds to return for a time on days 1-2 (15-16 Oct) due to any further transitory CME influence or a possible connection to coronal hole fast winds from CH79/+ in the southern disc. While this coronal hole was present on the previous rotation and showed no notable enhancement, it now displays a more northward extension. Confidence remains low for this being observed, with Earth currently north of the ecliptic. A more notable coronal hole enhancement possible into day 4 (19 Oct) in association with the large CH80/+, currently near center disk. This feature is significantly larger than the previous rotation, and an increase in solar winds towards slightly elevated to elevated speeds looks likely by the end of the period.

MOSWOC ENLIL output is providing little guidance. Currently over-estimating the extent of the fast wind from the southern disc, and has little signal for CH/80/+ later in the period. This likely due to current limitations with GONG H-alpha imagery that is used for the initialisation of the model.

Overall geomagnetic activity is expected to be mainly Quiet to Unsettled. There is a likelihood of Active intervals both to start and end the forecast associated with CME arrival or coronal hole influence, and there is a chance of isolated G1 Minor Storm intervals day 1 (15 Oct) given uncertainty with potential CME arrival.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	30	10	1	10
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
12/0102	Nil	AR3854	27E 01S	480	Early 15 Oct	Low confidence. Glancing impact at most.

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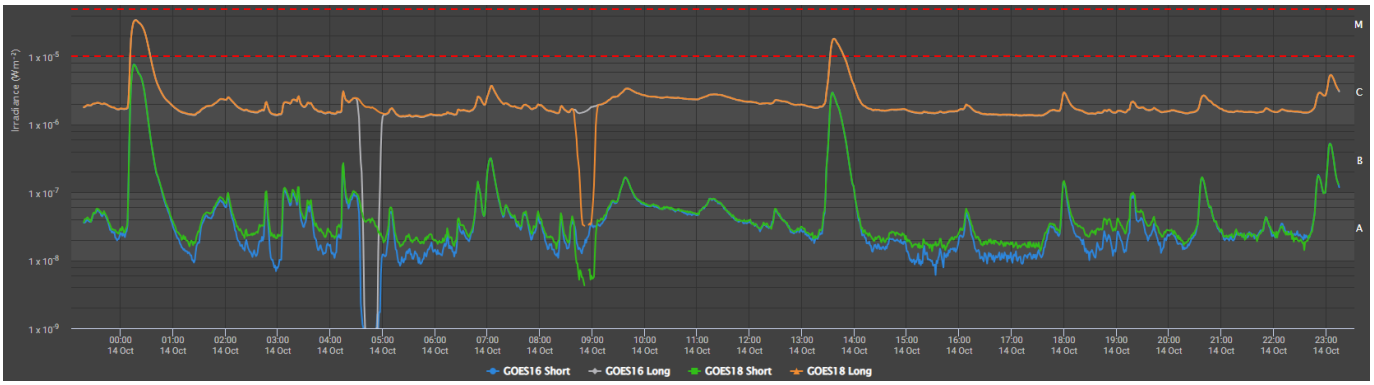
Radio Blackouts - X-Ray Flares

There are eight sunspot regions on the Earth facing disc. AR3848 remains of interest, however it is now approaching the northwest limb with the flare risk from this region declining through the first half of the period. AR3852 and AR3854 in the south-centre form a coupled pair of sunspots. While so far largely inactive and having shown some simplification with the loss of intermediate spots, the regions continue to show some interconnected magnetic loop structure in e.g. SDO aia-211 and present the bulk of the current flare risk. No significant returning regions are expected during the period, and pending further developments flare risk is expected to decline somewhat.

Low to Moderate activity is expected to continue with a chance of isolated M-class flares and a slight chance of X-class flares. These most likely from AR3848 in the near term.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	Yes	40	35	30	30
Very Active	R3-R5 (X Class)	No	5	5	1	1

Figure 2: Latest 24hr GOES16/18 X-Ray trace



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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is expected to remain at background, but there remains a slight chance of enhancement given any notable flares, primarily from AR3848 in the near term, but also possible from any AR3852/54 flare, especially as this region moves further onto the western disc.

Any enhancement will bring a slight chance of reaching the S1 Minor Radiation Storm threshold.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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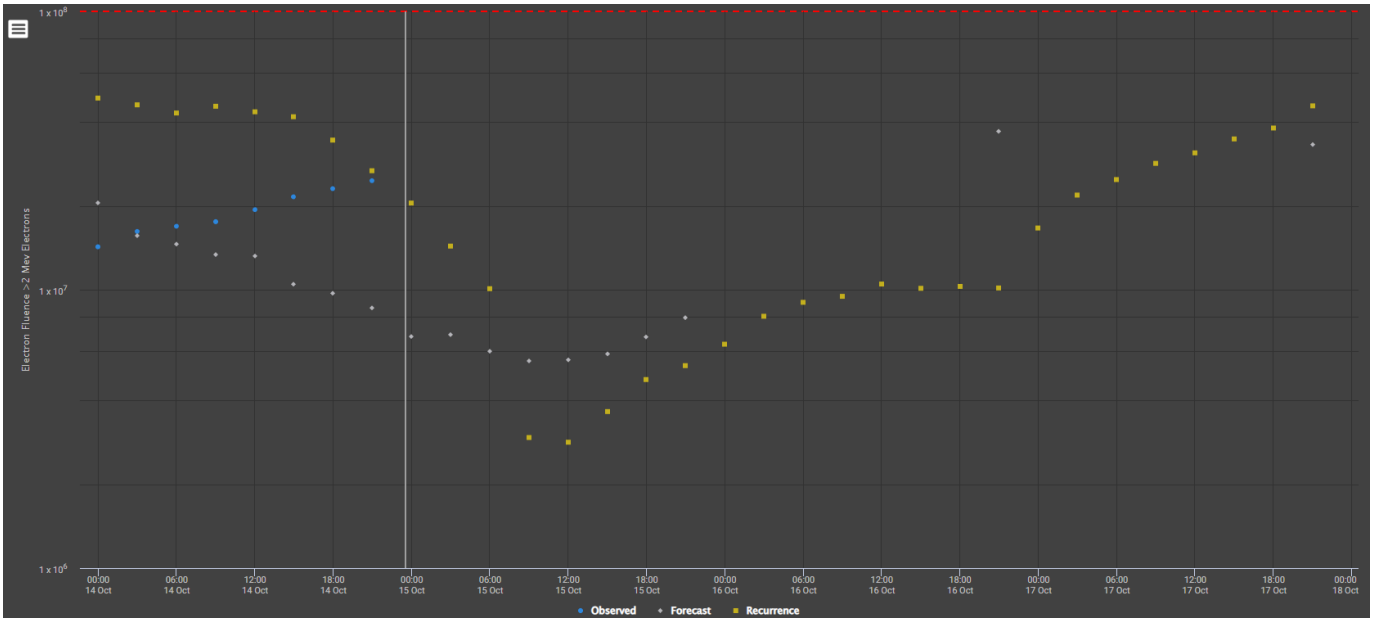
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES-16 is currently persistently Moderate. The recent significant CME arrival and subsequent strong solar winds have likely increased counts at lower orbits, with the Van Allen belts compressed inward by the ongoing solar wind pressure. As solar winds ease, flux is expected to rise at GEO to become Moderate to High with a chance of becoming perhaps persistently High by day 1 (15 Oct). However, this is low confidence, and confidence is further lowered by ongoing and further potential CME arrivals into the early part of the period or high speed stream onset by day 4 (18 Oct). Any such enhancement is likely to suppress flux at GEO to background levels again, but with low confidence

The associated electron fluence is therefore expected to be below the Active level (1e8 total pfu), but with a rising trend to start. This will bring a increasing chance of Active fluence into days 2 and 3 (16-17 Oct). MOSWOC REFM model output is not viewed as providing significant guidance due to the impact of recent CMEs.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	20	30	30	20
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 3: Latest MOSWOC REFM model output.



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